

*If you are using a printed copy of this procedure, and not the on-screen version, then you **MUST** make sure the dates at the bottom of the printed copy and the on-screen version match.
The on-screen version of the Collider-Accelerator Department Procedure is the Official Version.
Hard copies of all signed, official, C-A Operating Procedures are kept on file in the C-A ESHQ Training Office, Bldg. 911A.*

C-A OPERATIONS PROCEDURES MANUAL

8.7 AGS Main Magnet Power Supply Operations Procedure

Text Pages 2 through 17

Hand Processed Changes

<u>HPC No.</u>	<u>Date</u>	<u>Page Nos.</u>	<u>Initials</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Approved: _____ *Signature on File* _____
Collider-Accelerator Department Chairman Date

J. Sandberg

8.7 AGS Main Magnet Power Supply Operating Procedure

1. Purpose

The purpose of this procedure is to provide operating instructions for the Main Magnet Power Supply.

2. Responsibilities

The on shift MMPS operators are responsible for the startup, operation, and record keeping of the MMPS and its auxiliary equipment.

3. Prerequisites

3.1 Startup

The MMPS operators will prepare the auxiliaries for the MMPS and will roll the MG set after receiving a request from the MCR Operations Coordinator (OC).

3.2 Excitation and Pulsing

3.2.1 The MMPS operators will enable the generator excitation upon receipt of a request from the MCR coordinator after the main ring in the AGS has been secured.

3.2.2 Pulsing of the Main Magnet requires parameter information such as flat top length, rep. rate and maximum power requirements. (Note: Max power in the MG Set should not exceed 7MW).

3.2.3 Pulsing of the Main Magnet requires clearance to start pulsing from the Operations Coordinator.

3.2.4 The cycle which the MMPS produces is determined by a computer generated function. The function must be developed and loaded into the local controllers and verified on an oscilloscope before pulsing begins.

3.3 Qualified and trained MMPS operator.

4. Precautions

4.1 Standard Operations

The MMPS operators shall assure that the MMPS is operating within its design limits and shall inform the MCR if any conditions or requests for operating modes will jeopardize the equipment.

Requests for shutdown and subsequent restart of the MG set shall be limited to one startup within four hours of a shutdown, i.e., if the MCR coordinator requests a shutdown he shall be informed that only one restart will be attempted within four hours. This requirement is to insure that the high power equipment is not subjected to undue wear and stress. If the MG Set trips without braking, it can be restarted three (3) times maximum in one hour. If it trips with braking, it can be restarted two (2) times maximum in one hour.

4.2 Trouble Shooting

Only the MMPS operators and other authorized Power Supply Group personnel shall investigate and probe the equipment in case of faults or poor performance. The MCR coordinator shall be informed as soon as possible as to the extent of the anomaly, and the estimated time to correct the situation to return the MMPS to normal operation.

Note:

ALL REQUIRED SAFETY PRECAUTIONS SHALL BE FOLLOWED AND
THE MMPS OPERATOR SHALL BE RESPONSIBLE FOR THE
DETERMINATION OF THE CONDITION OF THE MMPS, BEFORE WORK
MAY PROCEED.

5. **Procedure**

- 5.1 MG set Start up Upon request from MCR coordinator, follow steps in 1 to 20 in Appendix I to bring MG set to Operating condition.
- 5.2 Excitation and Rectifier Turn on. Follow steps 1 to 15 in rectifier turn-on procedure, Appendix III.
- 5.3 Shutdown.
 - 5.3.1 Motor shutdown using motor brake. Follow steps 1 & 2 in Appendix II.
 - 5.3.2 Rectifier Shutdown. Follow steps 1 Appendix IV.
 - 5.3.3 MG Set Shutdown. Follow steps 1 to 5 in Appendix V.
 - 5.3.4 MG Set shutdown for long periods. Follow steps 1 to 6 in Appendix VI.

6. **Documentation**

- 6.1 A bound log book shall be maintained by the senior MMPS operator and shall include all alarms, operating changes (when informed by MCR), fault conditions and resolutions, times of occurrence and shall have a watch transfer statement indicating personnel coming off watch and those coming on watch. Oncoming senior watch shall record condition of MMPS at time of watch transfer.

- 6.2 Standard watch operating data shall be recorded in the watch data book twice a shift.

7. References

None

8. Attachments

- 8.1 Appendix I - AGS Main Magnet Power Supply Detailed Operating Procedure.
- 8.2 Appendix II Motor Shutdown Using Motor Brake.
- 8.3 Appendix III for Excitation and Rectifier Turn On.
- 8.4 Appendix IV Shutdown of Rectifiers.
- 8.5 Appendix V Shutdown of the MG SET.
- 8.6 Appendix VI Securing AGS MMPS for Long Periods.
- 8.7 Appendix VII LOTO of AGS MMPS Systems (Rectifiers, Cycloconverter, Exciter & MG Set).

AGS MAIN MAGNET POWER SUPPLY OPERATING PROCEDURES

APPENDIX I

MG SET STARTUP

AFTER LOTO PROCEDURE IS COMPLETED THE FOLLOWING STEPS SHALL BE EXECUTED.

NOTE: Steps 1 thru 7 are for long term shutdown not normal LOTO of AGS MMPS to enter the ring.

- 1) Turn on dc breakers in LE2 except for E1e7.
- 2) Turn on all ac, PP44.1 A1, A2, & B1, EPP44.2-4, 5, 6, and 9.
- 3) Secure and lock liquid rheostat gate. Make sure two heat exchangers are on line.
- 4) Rack-in high voltage motor breaker 52M (L14),

Warning:
Do not hit the “ON” button
- 5) Check MG cooling water temperature. It should not exceed 75 degrees F/20 degrees C.
- 6) Turn on dc breaker E1e7 in LE2.
- 7) Turn on dc breaker A4e01 in LA2 left.
- 8) Close new 95S Switches which attach MMPS to ring magnets and check in the 242 area that there are no ground cables used to ground ring magnets instead of new 95S Switches.
- 9) Check that all kirk lock keys are in the key exchange at the control console LE1.
- 10) To operate the MG Set, identify the “motor controls” on +CR1 cubicle (in new control room). The key switches should be in local and manual. To start the motor aux. press the “stby/reset” push button.
- 11) Check the following at the MG SET:
 - A. All doors in the MG Room are closed & locked
 - B. Crane is clear
 - C. Valves for shaft pump open

D. Check the oil flow of bearings	#1-190 L/MIN $\pm 15\%$
	#2-190 L/MIN $\pm 15\%$
	#3- 10 L/MIN $\pm 15\%$
E. Check the oil pressure of bearings	#1 60 KP/cm ² $\pm 15\%$
	#2 70 KP/cm ² $\pm 15\%$
	#3 60 KP/cm ² $\pm 15\%$

- 12) Check that the motor controls fault light on +CR1 Rack clears.

If it did not clear, press the stby/reset push button again. You may have to wait 3-4 minutes until the fault light clears.

If it still does not clear then check the motor start interlock string with switch (A11b3) in cubicle LA1-R and reset all faults in LA1-R, 1GH, also reset all relays in LA71, 72, 73, 74. If the fault light clears, then we are ready to turn on motor.

- 13) Confirm that all personnel are accounted for and are clear of rotating equipment.
- 14) To turn on motor make sure the 19S circuit breaker is closed (red light on +CR1 Rack), then press the motor controls (52 & 18R) "on" push button. This should close 52 and 18R circuit breaker and then red lights of +CR1 for these circuit breaker should be on. This should be done within 10 minutes of the start of the auxiliaries. If not, auxiliaries must be turned off, and restarted.
- 15) The MG Set will start and should reach approximately 1200 RPM in about 2.5 minutes. (NOTE: On +CR1 Rack the N=0 light should go out when set starts to turn). At about 980 RPM the pressure oil pumps should go off (LA1 "oil pumps on light" will go out).
- 16) Check the following gauges at the MG Set:

Check Oil Flow In Bearings	#1 - 190 L/MIN $\pm 15\%$
	#2 - 190 L/MIN $\pm 15\%$
	#3 - 12 L/MIN $\pm 15\%$
Check Oil Pressure In Bearings	#1 = 35/22 KP/cm ² $\pm 15\%$
	#2 = 52/32 KP/cm ² $\pm 15\%$
	#3 = 30 KP/cm ² $\pm 15\%$

Shaft Pump Pressure Side = 17 -25 PSI $\pm 15\%$

Shaft Pump Suction Side = 10" VAC, $\pm 15\%$

- 17) Check in Rack 5090 the panel view term. On the motor status screen check the motor/generator warnings are not flashing.

If it is flashing, press warning page (F3) to identify warnings then call Mechanical Engineer (V. Badea), Electrical Engineer (I. Marneris) and Siemens Supervisor (M. Bannon).

- 18) To operate the cycloconverter, identify the “cycloconverter controls” on +CR1 rack. The key switches should be in local and manual. Press “stby/reset” one or two times and make sure the fault light indicates no faults.

If fault light is on, check RK5090 panel view terminal. Under cycloconverter Page 1 of 6.

If fault light is flashing, go to “fault page” F8 and identify faults on the following 4 pages. If faults does not clear, contact Electrical Engineer or responsible person from call-in list. If all faults are cleared, make sure in +CR2 rack that the Symadyn OP2 display WNOP = 1212.01 RPM if not, set the WNOP as per operating procedure.

(NOTE: Refer of operating procedure for Symadyn OP2 in Siemens procedure book).

- 19) When cycloconverter shows no faults and WNOP is set 1212 RPM or 101% press the cycloconverter controls “on” push button on +CR1 Rack. (This should close -52R circuit breaker first then 3 seconds later close -19R, -19N circuit breakers and open -19S circuit breaker). Observe in +CR1 Rack the slip is equal to -1% on meter and green light ($S \leq 2\%$ is “on”). Also the 52R, 19R, 19N red light should go on in the +CR1 Rack showing “on” status for those circuit breakers. If not true, press “stby/reset” push button of the cycloconverter controls and notify the engineer in charge.
- 20) MG set will speed up to the speed called for by the Simadyn speed regulator in +CR2 Rack.

APPENDIX II

MOTOR SHUTDOWN USING MOTOR BRAKE

- 1) If the operator determines there is a problem in the motor and chooses to apply the brake due to a emergency.

First in +CR1 Rack “motor controls” press the stby/reset push button.

Then press motor brake pushbutton in +CR1 Rack which will close 52B circuit breaker and 42B contactor. The set should stop in approximately 3 minutes and 20 seconds. The horn acknowledge pushbutton is in LD1 in the old control room. This button will silence the horn for approximately 5 minutes and the horn circuit is then reinstated.

- 2) The motor brake should not be the normal way of turn off the motor unless specified by the operating engineer.

APPENDIX III
FOR EXCITATION AND RECTIFIER TURN ON

- 1) Contact Pump Room personnel and verify that the cooling water systems are on and fully functional.

Note:

All interlocks which cause a Protection Level 4 (PL4) or above, must be satisfied to turn the rectifier on.

- 2) If work has been performed within the rectifier modules, visually inspect the modules to insure that no tools or other materials have been left behind.
- 3) Check to see that all modules are locked and that the fenced in area (south end of the rectifier room) is locked. (Both doors.)
- 4) Make sure all Kirk keys are in the key exchange on the north wall of the rectifier room.
- 5) Turn on the 480 at PP 44-1A in the siemens basement.
- 6) Make sure the following breakers and FDS are closed:
 - a: FDS5061 - 5069 (480 To the modules)
 - b: LP5071 (UPS)
 - c: LP 5070 (House power to the modules)
- 7) Reset racks LD1, LA2R, LA2L, LC1-IP & IIP, LB1-IP & IIP, LE2 & LE3
- 8) Close breaker 52E (A31a1) using control switch A31b1 on LE1 console (old control room).
- 9) In rack 5074 (new control room) make sure local/remote switch is in "local" and 52G control switch is in "local" then press stby/reset pushbutton and reset "lockout relay" if tripped.
- 10) Stand-by light should go "on" after approximately 5 seconds and fault light should clear. If not, press stby/reset several times until fault light clears.

If fault light does not clear, identify all faults registers on control view terminal in RK 5074.

- 11) When all faults are cleared, make sure on the control view panel AGS MMPS screen that the following conditions are true;
 - 1) 89 Switch I & II should be closed.
 - 2) Fast and slow 95Ia & Ib, 95 IIa & IIb are open.
 - 3) Also 95S I & II switches should show AGS MMPS attached to ring magnets.
- 12) Load computer generated functions in Rack 5082. First load buffers and note if when loading buffers, warning signals appear on console screen identifying difference between function loaded in buffers and calculated values. Reload buffers until no differences are found. Then "Make Live" (execute) repeat cycle.

Note:

Identify what program should be running (ex. Siemens or Westinghouse). Start - AGS Main Magnet Program. Go to Setup - then select the appropriate motor-generator set.

- 13) In Rack 5084 compare four voltage references and one current reference (MD 1 & 2, 3 & 4, 5 & 6, 7 & 8 V ref. and I out) with the reference on the console as per MCR or engineer. Also compare the "power reference" to the power reference in Rack 5090 (1v = 1MW)
- 14) In Rack 5074 press the "on" pushbutton to turn on rectifiers.
- 15) In Rack 5084 verify and compare V ref. and V out and I ref. and I out look the same. If signals look corrupted, store the waveforms on scope and turn off the rectifiers by pushing stby/reset push button in Rack 5074.

APPENDIX IV

SHUTDOWN OF RECTIFIERS

- 1) Stop pulsing “(rectifiers off)” by pressing “standby/reset” push button in Rack 5074, this opens circuit breaker 52G.

APPENDIX V

SHUTDOWN OF THE MG SET

- 1) Rectifiers must be off first (Rack 5074 press stby/reset pushbutton) (52G opens).
- 2) In +CR1 Rack "Cycloconverter Controls" section, press stby/reset pushbutton. (-52R C.B. should open, -19R C.B. and -19N C.B. should open and -19S C.B. should close).
- 3) In +CR1 Rack "Motor Controls" section, press stby/reset pushbutton (-52 & -18R should open).
- 4) When the RPM of motor reaches 500 RPM, press "motor controls" stby/reset pushbutton again to insure lift pumps stay on until motor stops.
- 5) When RPM=0, press "AUX OFF" button on +CR1 "Cycloconverter Controls" which will turn off fans on top of =13U, V, and W racks.

APPENDIX VI

SECURING AGS MMPS FOR LONG PERIODS

- 1) Switch off dc breakers in LE2 & A4e01 in LA2 left (& LOTO).
- 2) Switch off ac breakers EPP44.2 - 4,5,6,& 9 and PP42 - A1, A2, & B1 (& LOTO).
- 3) Rack out breaker 52M (A11a1) IN L14 (& LOTO).
- 4) Open 89 switches.
- 5) Open 52G breaker.
- 6) Lock pneumatic valve in cubicle (L4) Closed.

Ground main magnets using new 95S Switches. (Refer to [C-A-OPM 2.6.6](#))

APPENDIX VII

LOTO OF AGS MMPS SYSTEMS (RECTIFIERS, CYCLOCONVERTER, EXCITER & MG SET)

I. LOTO of AGS MMPS Rectifiers

- 1) Turn rectifiers to stby, press stby/reset push button in Rack 5074. (This opens 52G).
- 2) Open the 89 Switches manually using switches A61b11 and A61b21 in old control console LE1.
- 3) Open 52E circuit breaker using A31a1 Switch on LE1 console.
- 4) In old control room at the LE1 console, simultaneously press the exciter kirk lock key release push button and turn kirk key #11000 (labeled 95 Switches/Filter) at position G1; this will release all kirk lock keys in this exchange.
- 5) Remove kirk keys #11003 and #11006 (positions G4 & G7).
- 6) Bring the 2 keys from step #5 and a Siemens High Voltage Cubicle Key downstairs to the side of the 89 Switch cubicles (L1).
- 7) Insert key #11006 into the generator breaker cubicle key tree exchange next to the 89 Switch cubicle on the wall. Simultaneously press the key release push button and turn the #11273 key to release all 7 #11273 keys.
- 8) Ensure the 89 Switches are open by visually inspecting the switches through the windows in cubicles L1 and L2.
- 9) Note: There are 3 possible ways at this time to power the AGS MMPS rectifiers. Only 1 feed must be connected to 52G Siemens at any one time. Therefore it is necessary to have all 3 feeds Lockout before entrance into L1, L2, L3, L4 is allowed. This is accomplished by having a 7 key tree exchange located on the side of L4. Whereby position 1, 2, 3 keys must be in place before it releases keys in positions 4, 5, 6, 7 (key #18598), which will allow access into cubicles L1, L2, L3, L4.

Note: At any one time, 2 of the keys should be in position 1, 2, 3 and only 1 missing since we want to feed (52G) Siemens from only 1 location at a time. The other 2 should be locked out.

The first feed key position #1 is Siemens M-G (Motor-Generator). Set which is locked out in steps 3, 4, 5, 6, 7 above. Therefore, take key #11273 and insert it into position #1 of the new 7 key tree located on the side of L4 cubicle.

Key position #2 of the new 7 key tree is key #RE10392H, which comes from the 13.8 kv switch, which feeds the 2.4 mw transformer located in the old RF subyard behind Bldg. 928. This key insures the 2.4mw transformer, which is the second possible feed to 52G Siemens is locked out.

Key position #3 of the new 7 key tree is #18596, which comes from CB (52G) Westinghouse M-G set. This key insures that CB (52G) Westinghouse is racked into a test position and locked out.

When all three of these keys are in the 7 key tree exchange, turn the button key 18598 position #7. This will release the 4 keys in position 4, 5, 6, 7. Take one of the 18598 keys and insert it into the "D" lock on the front door of L4 and open the kirk lock. Also use a Siemens high voltage key and open the front door of L4.

- 10) Insert key #11003 into the kirk lock air valve key exchange. Turn the air off and lock the air off then remove one key #17251.
- 11) Bring this key upstairs to the rectifier room to the rectifier room power supply key tree exchange. Insert the #17251 key into the top of the exchange which will release all #RE11600 keys which allow access into the rectifiers and the cage area behind the rectifiers.
- 12) Reverse steps 11 thru 2 after work on the rectifiers is completed, so rectifiers are then brought back to a "ready state".

2. LOTO of AGS MMPS Cycloconverter

- 1) Turn rectifiers to stby by pressing stby/reset pushbutton in Rack 5074. (This opens 52G).
- 2) In +CR1 Rack "Cycloconverter Controls" section, press stby/reset push button (This opens -52R, then -19R and -19N should open and -19S should close)
- 3) In +CR1 Rack "Motor Controls" section, press stby/reset push button. (This opens -52 and -18R).
- 4) When the RPM of the motor reaches 500 RPM, press "Motor Control" section stby/reset push button again to insure lift pumps stay on until motor stops.
- 5) When RPM=0, press the "off" push button on +CR1 "Cycloconverter Controls" section, this will turn off the 480 vac 3ø to fans on the top of racks = 13U, =13V and =13W.

- 6) LOTO 480 vac 3Ø disconnect switch in the rectifier room enclosure 5091.
- 7) LOTO 208 vac 3Ø disconnect switch in old control room next to LG1 Rack enclosure 5092.
- 8) Rackout and LOTO circuit breaker -52R and -19R in Siemens basement.
- 9) Reverse steps 8 - 6 to bring cycloconverter out of a LOTO state. Refer to Appendix I for MG set start up.

3. LOTO of AGS MG Set Exciter

- 1) Rectifiers must be off. (Refer to Appendix IV)
- 2) Open 52E circuit breaker using A31a1 Switch on LE1 console. (This is circuit breaker 43 outside in the old RF transformer yard behind Building 928).
- 3) Line Crew must be notified to rackout this circuit breaker.
- 4) Install LOTO on this circuit breaker 43 (-52E) while working in exciter racks.
- 5) Notify line crew when work is complete. Remove LOTO and ask them to rack circuit breaker 43 back in. Refer to Appendix III for Excitation.

IV LOTO of AGS MG Set

- 1) Rectifiers must be off; press stby/reset push button in Rack 5074.
- 2) MG Set must be stopped, refer to Appendix V.
- 3) Rackout C.B. -52M, -52R, -19R and -19S.
- 4) Notify line crew supervisor that we want our 13.8KV 3Ø feeder off, (C.B. 911-15) racked out and a ground breaker installed. Then go down to Temple Place Building 603 and install our lock and tag of this circuit breaker. When LOTO is installed on circuit breaker 911-15, take this key to the lock box outside the 242 area and the Siemens Supervisor shall install his lock on this box locking this key in the box becoming the responsible person (1st on; last off). He shall then open the front door of L13 in building 928 basement and verify the 13.8 KV voltage is off and then install grounds on 13.8KV cables coming from Building 603 circuit breaker 911-15 load side. All other personnel working in these cabinets shall install their lock and tags on the lock box while they are working and remove them when they are finished.

- 5) Also have the line crew rack out circuit breaker 43 (-52E) exciter circuit breaker in old R.F. trans. Yard, then LOTO.
- 6) If the 125 VDC needs to be secured so people can work in the relay racks go to the 125 VDC circuit breaker panel box located in old control room (North wall) next to control room entrance. CB#8 should be “first one turned off and the last one turned on” (This circuit breaker controls power for lift pumps cir. A4). After circuit breaker #8 is off then turn off 6, 4, 2, 1, 3, 5, 7, and 10 then install LOTO on the circuit breaker panel box. Circuit breaker #9, 11, 12 are already LOTO.

Note: This only secures the 125VDC; check with a tic-tracer or volt meter before manipulating any wires on relays. If voltage is found, refer to drawings, find voltage source and LOTO.

- 7) Reverse steps 6-3 when work is completed and MG Set is brought back to a “ready state”.